Introduction

Chapter 1
Page 1

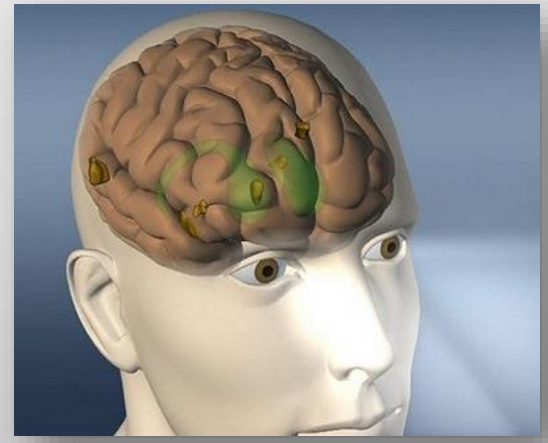
NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
INSTITUTIONAL OFFICE

Lecture outline

- What is Artificial Intelligence?
- The Foundations of Artificial Intelligence
- The History of Artificial Intelligence
- The State of the Art

Introduction

Homo sapiens



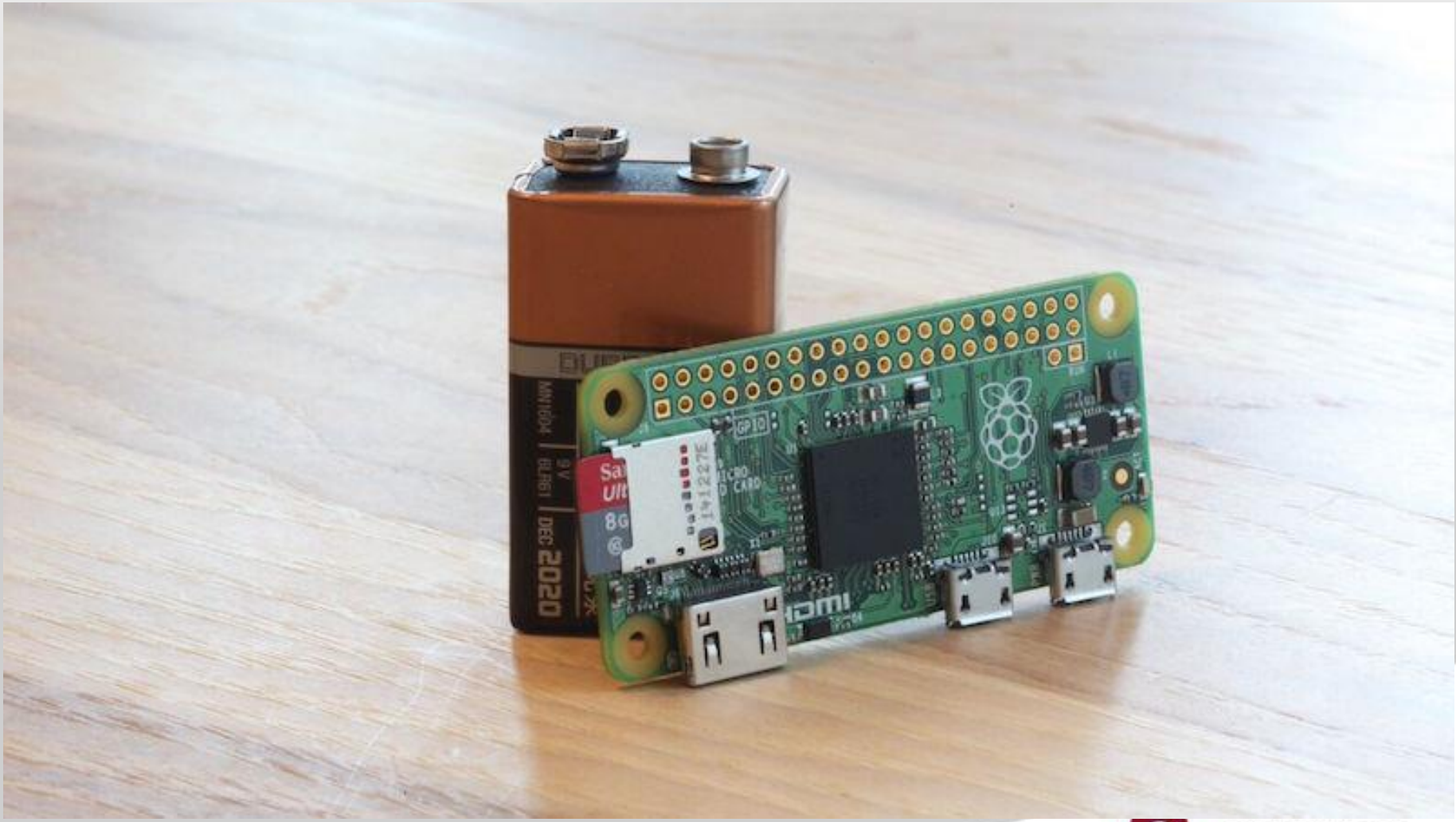
Introduction

- Artificial Intelligence is a new field (1956)
- Scientists from other fields would like to work in this field
- Opportunities exist
- Consists of many sub fields
- An universal field

Introduction

- Artificial Intelligence tries to
  - Understand intelligent entities
  - Learn more about humans
- Has the human as an example to study
- Differ from Philosophy and Psychology
  - Try to build intelligent entities

Raspberry Pi computer



What is AI?

1 "The exciting new effort to make computers think … machines with minds, in the full and literal sense." "[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning…"	2 "The study of mental faculties, through the use of computational models." "The study of the computations that make it possible to perceive, reason, and act."
3 "The art of creating machines that perform functions that require intelligence when performed by people." The study how to make computers do things at which, at the moment, people are better."	4 "Computational Intelligence is the study of the design of intelligent agents." "AI … is concerned with intelligent behaviour in artifacts."

What is AI?

"The exciting new effort to make computers think … *machines with minds*, in the full and literal sense." "[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning…"	"The study of mental faculties, through the use of computational models." "The study of the computations that make it possible to perceive, reason, and act."

What is AI?

"The exciting new effort to make computers think … *machines with minds*, in the fu… and literal se… "[The aut… of] acti… we ass… human t… activities s… decision-maki… problem solving, learning…"	"Th…udy of m…ulties, …se of …f the …ions that …t possible to …eive, reason, …d act."

Thought processes and reasoning

What is AI?

"The art of creating machines that perform functions that require intelligence when performed by people." The study how to make computers do things at which, at the moment, people are better."	"Computational Intelligence is the study of the design of intelligent agents." "AI … is concerned with intelligent behaviour in artifacts."

What is AI?

“The art of creating machines that perform functions that require intelligence when performed by people.” The study of how to make computers do things at which, at the moment, people are better.”	“Computational Intelligence is the study of the design of intelligent behaviour in artifacts.”

Behavior

What is AI?

"The exciting new effo
make computers thi
machines with mi
the full and lit
"[The auton
activities
with h
acti
n

people."
Th ow to make
computers do things at
which, at the moment,
people are better."

Human as standard

What is AI?

"The study of ment
faculties, throug
of computatio
"The study
computa
possib
rea

with
aviour in

Rationality as standard

What is AI?

"The exciting new effort to mak computers *machine minds* an ch ng, uch as making, m solving, learning…"	"The study of mental faculties through the us computation dels." he st com m

Systems that think like humans

Systems that think rational

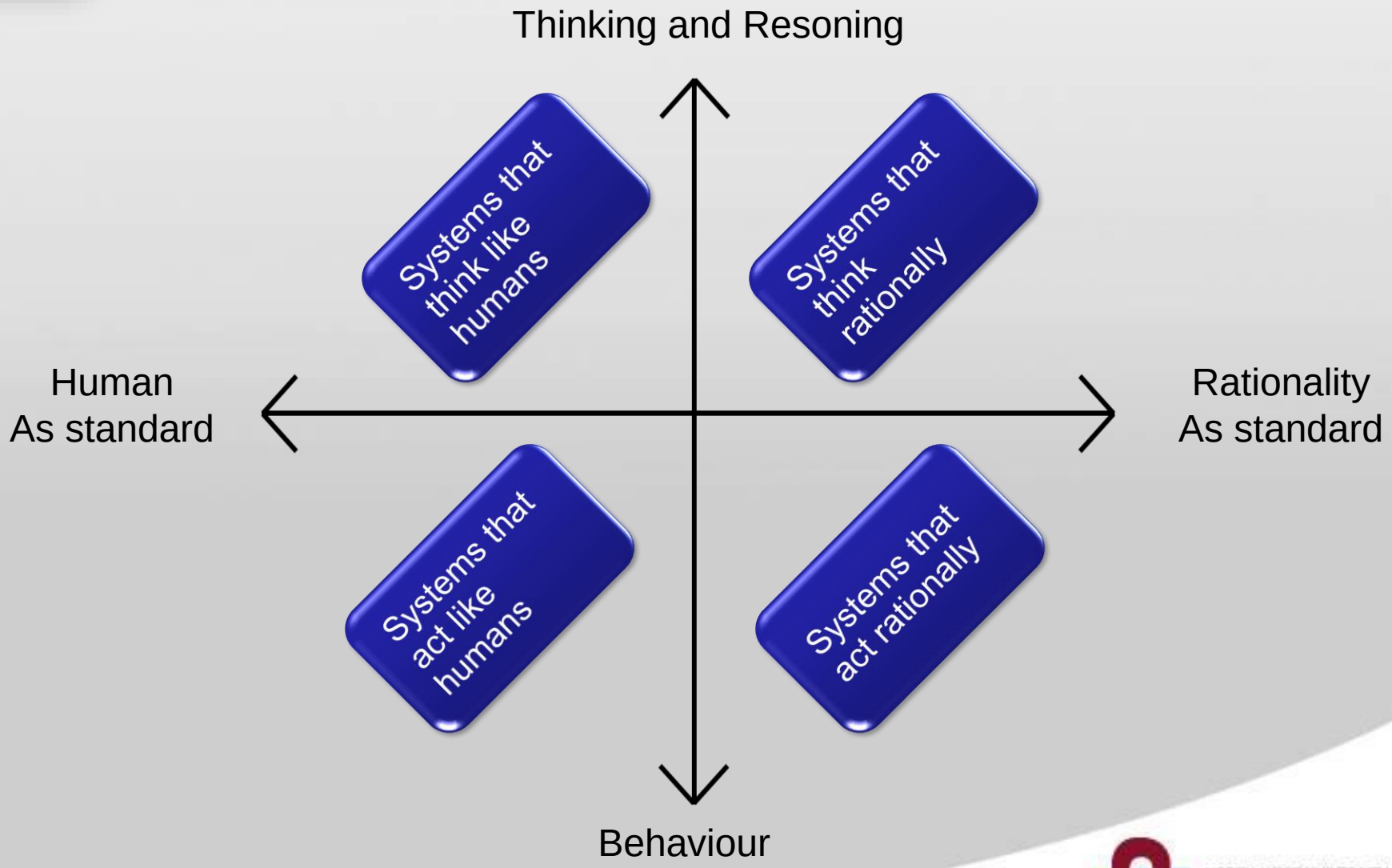
What is AI?

"The art of creating machines that perform funct… that requir… intelliger… perfor… peo… T… …'s do …ich, at …ent, people ar… …tter."	"Computational Intelligence is the …udy of the de… …telligen… …nts." "AI … i… with… b…

Systems that act like humans

Systems that act rational

What is AI?



What is AI?

- Systems that act like humans (the Turing Test approach)
  - Natural language processing
  - Knowledge representation
  - Automated reasoning
  - Machine learning
- Total Turing Test
  - Computer vision
  - Robotics

What is AI?

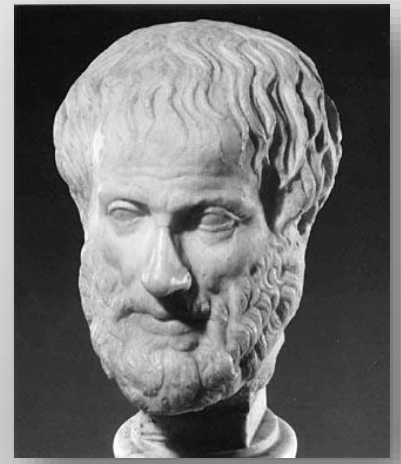
- Systems that think like humans (the cognitive modeling approach)
- We learn about how humans think through
  - Introspection
  - Psychological experiments
  - Brain scans
- Must first understand how our brain functions (theory)
  - Implement the theory as a computer program
  - GPS (general problem solver) by Newell and Simon (1961)
  - Cognitive science

What is AI?

- Systems that think like humans (the cognitive modeling approach)
- We learn about how humans think through
  - Introspection
  - Psychological experiments
  - Brain scans
- Must first understand how our brain functions (theory)
  - Implement the theory as a computer program
  - GPS (general problem solver) by Newell and Simon (1961)
  - Cognitive science

What is AI?

- Systems that think rational (the laws of thought approach)
  - Aristotle tried to define “right thinking”
  - Syllogisms
  - Logic
  - Logistic tradition
  - Two obstacles
    - Must express informal knowledge in logic
    - Difference between solving a problem in principle and doing so in practice



What is AI?

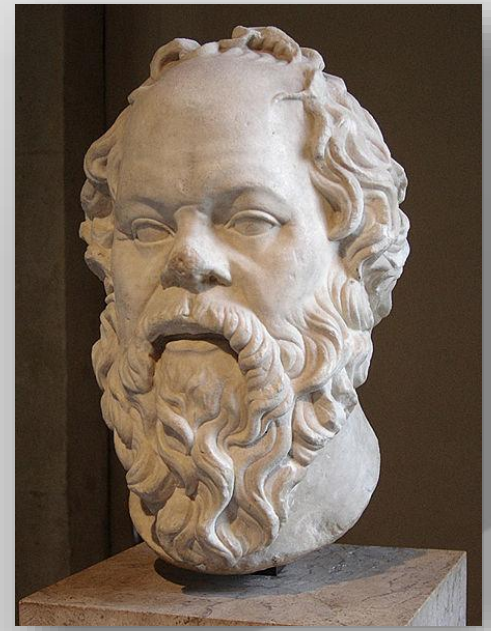
- Systems that act rational (the rational agent approach)
  - Agent acts (Latin *agere* = to do)
  - Act to achieve goals given beliefs
  - An agent is something that perceives and acts
  - In some situations an agent can make correct conclusions
  - Situations where there are nothing (provable correct) to do, but something must be done

What is AI?

- Systems that act rational (the rational agent approach) (continued)
  - Two advantages
    - More general than laws of thought
    - More general and amenable to scientific development than approaches based on human behavior or human thought
- We follow rational agent approach
- Perfect rationality is impossible in complex environments

The Foundations of AI

- Philosophy (428 B.C. to present)
  - Plato (428 B.C.)
  - Socrates (master) and Aristotle (student) laid foundation of western thought and culture
  - Syllogisms
  - The mind as a physical system
  - Descartes (Dualism)
  - Materialism holds that the mind functions according to physical laws



The Foundations of AI

- Philosophy (continued)
  - Empiricism
  - Hume introduced induction
  - Russel – logical positivism
  - Carnap and Hempel – confirmation theory
  - Connection between knowledge and action
  - Goal-based analysis

The Foundations of AI

- Mathematics (c. 800 to present)
  - Computation, logic, probability
  - Study algorithms - al-Khowarazmi (Iranian mathematician)
  - Logic as a formal language – Boole
  - Frege and Tarski continued the work
  - Hilbert – is there an algorithm that can determine the truth value of any logical statement?

The Foundations of AI

- Mathematics (continued)
  - Are there limits to the power of proof procedures?
  - Gödel proved it exists for first-order logic, but not in general
  - Induction is the problem
  - A class of problems is intractable if the time increases exponentially with the size of the instances

The Foundations of AI

- Mathematics (continued)
  - Reduction – reduce one problem to another
  - "NP-completeness"
- Economics (1776 to present)
- Neuroscience (1861 to present)
- Psychology (1879 to present)
- Computer engineering (1940 to present)
- Control theory (1948 to present)
- Linguistics (1957 to present)

The History of AI

- The gestation period (1943 to 1955)
- The birth of Artificial Intelligence (1956)
- Early enthusiasm (1952 to 1969)
- A dose of reality (1966 to 1973)
- Knowledge based systems (1969 to 1979)
- Artificial Intelligence becomes an industry (1980 to present)

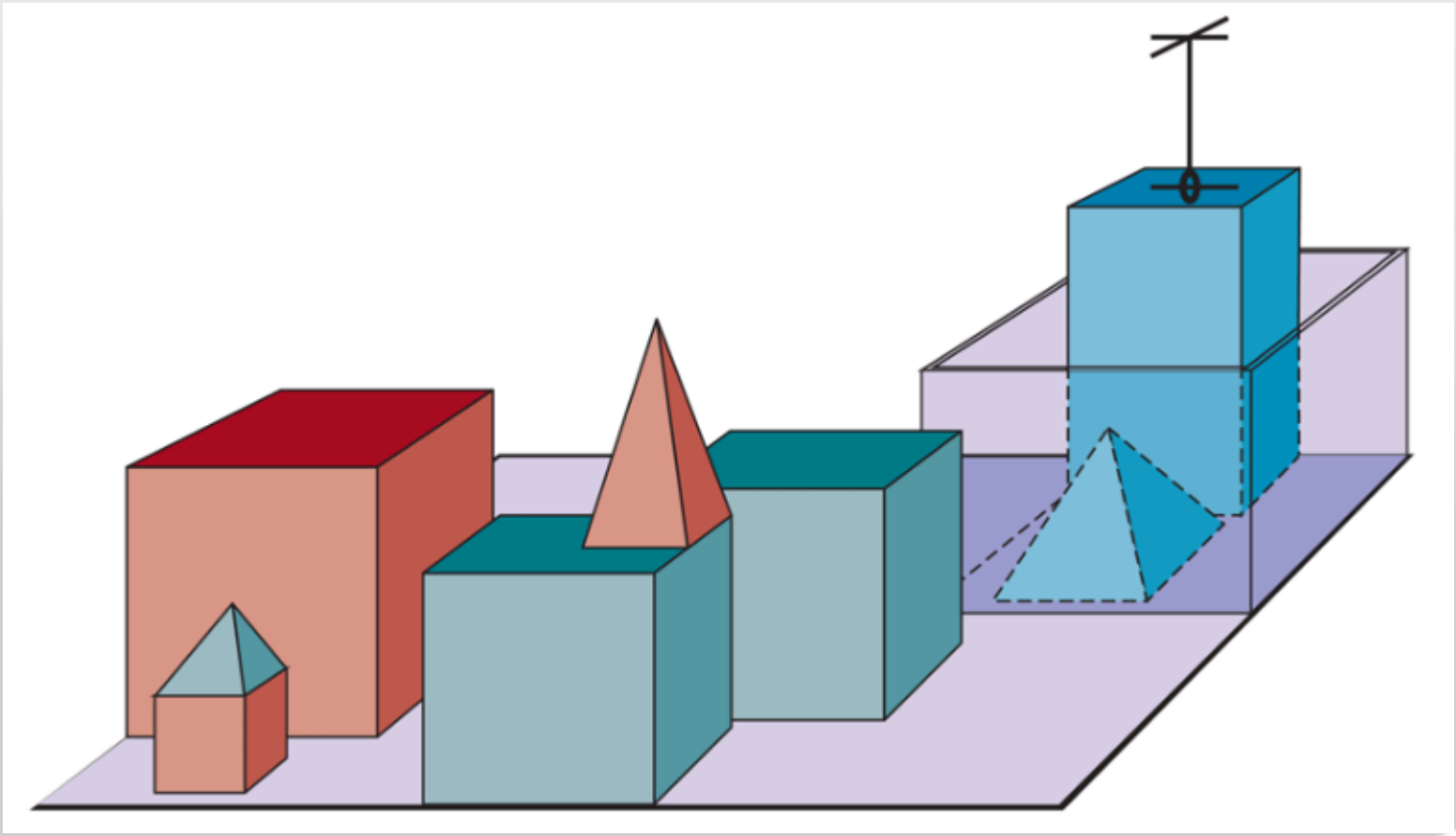
The History of AI

- The gestation period (1943 to 1955)
- The birth of Artificial Intelligence (1956)
- Early enthusiasm (1952 to 1969)
- A dose of reality (1966 to 1973)
- Knowledge based systems (1969 to 1979)
- Artificial Intelligence becomes an industry (1980 to present)

The History of AI

- The gestation period (1943 to 1955)
- The birth of Artificial Intelligence (1956)
- Early enthusiasm (1952 to 1969)
- A dose of reality (1966 to 1973)
- Knowledge based systems (1969 to 1979)
- Artificial Intelligence becomes an industry (1980 to present)

The History of AI



The History of AI

- The gestation period (1943 to 1955)
- The birth of Artificial Intelligence (1956)
- Early enthusiasm (1952 to 1969)
- A dose of reality (1966 to 1973)
- Knowledge based systems (1969 to 1979)
- Artificial Intelligence becomes an industry (1980 to present)

The History of AI

- The gestation period (1943 to 1955)
- The birth of Artificial Intelligence (1956)
- Early enthusiasm (1952 to 1969)
- A dose of reality (1966 to 1973)
- Knowledge based systems (1969 to 1979)
- Artificial Intelligence becomes an industry (1980 to present)

The History of AI

- The gestation period (1943 to 1955)
- The birth of Artificial Intelligence (1956)
- Early enthusiasm (1952 to 1969)
- A dose of reality (1966 to 1973)
- Knowledge based systems (1969 to 1979)
- Artificial Intelligence becomes an industry (1980 to present)

The History of AI

- The return of neural networks (1986 to present)
- Artificial Intelligence becomes a science (1987 to present)
- The emergence of intelligent agents (1995 to present)
- The availability of very large data sets (2001 to present)

The History of AI

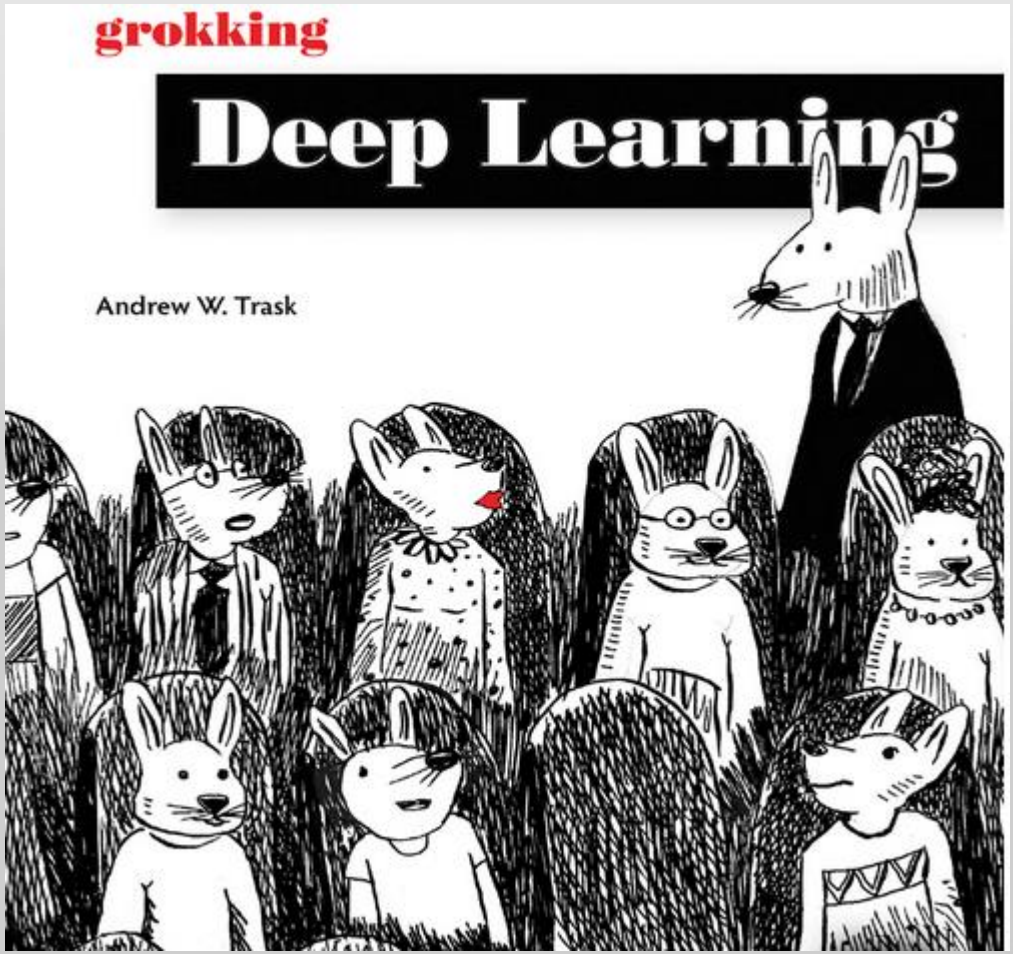
- The return of neural networks (1986 to present)
- Artificial Intelligence becomes a science (1987 to present)
- The emergence of intelligent agents (1995 to present)
- The availability of very large data sets (2001 to present)

The History of AI

- The return of neural networks (1986 to present)
- Artificial Intelligence becomes a science (1987 to present)
- The emergence of intelligent agents (1995 to present)
- The availability of very large data sets (2001 to present)

The History of AI

- Deep Learning (2011 – present)



State of the Art

- Autonomous planning and scheduling
- Game playing
- Autonomous control
- Diagnosis
- Logistics planning
- Robotics
- Language understanding and problem solving

Next week

- Next week we will have a small eFundi quiz on chapter 1 content